

SHORT COMMUNICATION

Aerial dispersal by *Actinopus* spiderlings (Araneae: Actinopodidae)

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Abstract. Ballooning, a form of dispersal rarely seen in mygalomorph spiders, was observed in 13 individuals of an undetermined species of *Actinopus* under laboratory conditions. After ascending a stick, each spiderling initiated ballooning from either the horizontal lines between sticks or from the stick's edges. They became airborne by dropping and dangling from a dragline, which then gradually lifted and lengthened to 10–15 cm in the breeze, broke at its attachment point, and served as a ballooning thread. This method of ballooning has also been observed in araneomorphs and other species of mygalomorphs, and this is probably a more primitive and shorter distance form of ballooning than that typically practiced by higher araneomorphs, which produce airborne silk lines that are pulled from the spider by air currents and are used either as spanning lines or as balloon lines that allow the spider itself to become airborne.

Keywords: Ballooning, mygalomorph, Argentina

Observations of the dispersal abilities of mygalomorph spiderlings have been rarely reported in the literature and have therefore been an arachnological curiosity, since average mygalomorph spiderlings are far more massive than the corresponding stages of araneomorphs (Coyle et al. 1985). In addition, the observations of ballooning behavior in mygalomorphs could contribute to the understanding of the evolution of aerial webs in other groups and give us insight into the pattern of dispersal from maternal burrows (Eberhard 2005).

Although it is well known that many araneomorph spiders disperse by ballooning (Decae 1987; Suter 1999), ballooning is thought to be only rarely employed by non-araneomorph spiders (Coyle 1983). Previous accounts of ballooning or pre-ballooning behavior in non-araneomorph spiders are easily summarized. The most complete observations are those of Coyle (1983, 1985) and Coyle et al. (1985) of *Sphodros* sp. (Atypidae) and *Ummidia* sp. (Ctenizidae); Eberhard (2005) reported on another *Ummidia* species. Spiderlings of these species moved along bands of silk lines and launched themselves into the air after dangling at the ends of draglines. Enock (1885) observed spiderlings of *Atypus piceus* (Sulzer 1776) (Atypidae) leaving their maternal tubes, trailing draglines and ascending plants, an apparent prelude to ballooning. Baerg (1928) described groups of spiderlings of *Ummidia carabivora* (Atkinson 1886) (Ctenizidae) dispersing from the maternal burrow along wide silk trails to elevated sites, but did not actually observe ballooning. Muma & Muma (1945) also observed silk bands produced by the spiderlings of *Sphodros rufipes* (Latreille 1829), and although they stated that the spiderlings dispersed by ballooning, they did not describe the ballooning process. Cutler & Guarisco (1995) observed a group of spiderlings of *S. fitchii* Gertsch & Platnick 1980 and apparent ballooning attempts at the top of a small tree. Main (1957) suggested that *Conothele malayana* (Doleschall 1859) spiderlings balloon, but only on the basis of observing fine threads of silk produced by spiderlings. Although strongly suggesting that these five mygalomorph species do balloon, these observations are incomplete and have understandably been treated with caution (Bristow 1939; Gertsch & Platnick 1980; Coyle 1983). This note reports an observation of dispersal and ballooning under laboratory conditions by spiderlings of an undetermined species of *Actinopus* (Actinopodidae), the first evidence of ballooning in this family.

One adult female of *Actinopus* sp. was collected on 20 October 2011 at Sierra de la Ventana (38°04'21.3"S, 62°03'02.6"W) (Buenos Aires

province, Argentina). Voucher specimens from this study were deposited in the collection of the Laboratorio de Zoología de Invertebrados II, Universidad Nacional del Sur (Bahía Blanca, Argentina). The spider was maintained in a plastic vial (10 cm high and 4.5 cm diameter) with a layer of soil approximately 8 cm deep, allowing the construction and observation of the burrow and trap door. We used a 12 h light/dark cycle, and the room temperature was 26.7 ± 1.52 °C. On 28 November 2012, an egg sac was observed inside the burrow. The pale yellow egg sac was nearly hemispherical in shape (diameter 13.3 mm), similar to that reported by Galiano & Goloboff (1996) for *Actinopus* cf. *insignis* (Holmberg 1881). The female's vial was transferred to a glass terrarium 30 × 35 cm and 30 cm high. It was placed on a substrate of polystyrene and two bunches of sticks, 15 cm high, were placed in the center of the container to allow the spiderlings to climb. At about 15:37 on 20 March 2013, an aggregation of four *Actinopus* sp. spiderlings was discovered inside the container. The period of spiderling emergence (during March) was the same as that reported in the field for an *Actinopus* species from the Ventania hilly system in southern Buenos Aires province (Ferretti et al. 2012). The lengths of 46 spiderlings from the dispersal aggregation, including chelicerae and spinnerets, averaged 3.58 mm (range 3.1–4.3 mm). The average width of the prosoma was 1.68 mm ($u = 10$, range 2.1–3.3). Spiderlings were weighed with an Ohaus PA313 Explorer Precision Balance. Mean spiderling weight was 5.83 mg ($u = 12$, range = 0.005–0.007).

During 1 h the spiders slowly walked on the silk mats from the burrow entrance and climbed to the margins of the terrarium. Spiderlings migrated in small groups from their mother's burrow to the ballooning site. They emerged one by one from under the lid, which was slightly open, and climbed up along a trail laid by previous spiderlings. At about 18:50 one group of four and one of five spiderlings walked along the silk threads and two of them ascended the sticks by walking and climbed on a dense silk mat 7 mm wide between two sticks (5–6 cm away). Although not observed in detail, previous spiderlings must have made this trip to deposit this dense silk mat. A band of silk about 2 mm wide extended from the margins of the terrarium along the stick surface (8–9 cm). At about 21:00, a fan of 15 cm diameter was placed 50 cm away from the container to generate a consistent air flow of about 200 CFM (cubic feet per minute). The spiderlings moved noticeably faster as they climbed up the ascent routes.

Then, at 21:33, 13 spiderlings ballooned by producing two or more draglines as they walked along horizontal lines. Some kept their spinnerets spread as they walked. Each spiderling walked upside down along aerial cables and ascended the sticks, finally arriving on the tip of the highest sticks. If not yet on the edge of a stick, the spiderling would walk to the edge. It would then tilt its cephalothorax upward, lift its first two pairs of legs and palps off the silk, and extend them out from the stick edge. Then, spiderlings dropped 10 to 15 cm down from the edge on their draglines and dispersed aurally, both from the horizontal lines between sticks and from the stick edges. The spiderlings descended slowly straight downward and facing downward, with their legs spread and immobile. The spinnerets were spread as the spider descended. Eventually the dragline would become long enough that the force of the breeze broke it near its point of attachment to the platform and the dragline, and the attached spiderling drifted through the air.

Successful launchings were observed very infrequently (five cases of 13 observed attempts). More commonly, after dropping on a dragline in the manner just described, the spiderling was either blown against the stick's surfaces (after which it ascended to repeat the launching process) or the spiderling drifted to the ground of the terrarium. By passing our hands through the air between the spiderlings and sticks after launching, we observed that some draglines attached to spiderlings after they were launched.

As observed for other mygalomorph genera, the *Actinopus* spiderlings migrated as a group from their mother's burrow to the ballooning site, forming a strong band of silk (Coyle 1983, 1985; Coyle et al. 1985). Such mass movement, and the resulting formation of compact aerial silk highways, is very unusual in araneomorph spiders. As proposed by Eberhard (2005), spiderlings may benefit from moving as groups; following lines established by nest mates may facilitate rapid movement to ballooning sites. This aerial dispersal mechanism could produce a scattered distribution pattern, as reported for *Sphodros rufipes* and *S. atlanticus* Gertsch & Platnick 1980 (Coyle & Shear 1981). Unfortunately, the spatial distribution of *Actinopus* species in the field has not been studied in detail.

The band of silk observed in this study extending from the margins of the terrarium along the stick surfaces probably marked the ascent route followed by most or all of the brood, as was seen in *Sphodros* sp. (Coyle 1983). As we observed in *Actinopus* spiderlings, both Coyle (1985) and Eberhard (2005) reported that spiderlings of *Ummidia* spp. walked with their spinnerets spread, producing at least two lines and probably more. The ability of spiderlings to walk upside down along aerial cables may be a very ancient trait, and as proposed by Eberhard (2005), it could have been important in facilitating the evolution of aerial webs in other groups.

This *Actinopus* method of ballooning by dropping and dangling from a dragline that is lifted and lengthened by the breeze, breaks near the substrate, and finally serves as the ballooning thread, has also been observed in araneomorphs such as dysderids and segestrids (Bristowe 1939, 1958). This is probably a more primitive and shorter distance form of ballooning than that practiced by higher araneomorphs (Coyle 1983), which produce airborne silk lines that are pulled from the spider by air currents and are used either as spanning lines that serve as bridges to distant objects or as balloon lines that allow the spider itself to become airborne (Eberhard 1987). Our observations of *Actinopus* ballooning are compatible with the hypotheses of the initiation of ballooning lines by dragline breaking proposed for other mygalomorphs by Coyle (1983, 1985) and Braendegaard (1938) for dictynid spiderlings.

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